

FOOD SCIENCE

5102

CIP Code: 02.0301

This course is a year long program that provides students with an overview of food science and its importance. Introduction to principles of food processing, food chemistry, nutrition, food packaging, food commodities, food regulations, and careers in the food science industry help students understand the role that food science plays in the securing of a safe, nutritious, and adequate food supply. A project-based approach is utilized along with laboratory, team building and problem solving activities to enhance student learning.

- Suggested Grade Levels: 11-12
- Recommended Prerequisite: Fundamentals of Agricultural Science and Business or by permission of the teacher
- A two credit/two semester course.
- This course may fulfill up to two credits of the minimum science requirement for graduation.
- A Core 40 directed elective as part of a technical career area.
- This course qualifies as an Academic Honors Diploma elective.
- Competencies and learning activities defined.
- This course is included as a component of the Agriculture and Natural Resources career cluster and may also be included as a component of the Engineering, Science, and Technologies, and Personal and Commercial Services career clusters.

Food Science

Unit 1: Consumer Education

Lesson 1: Food Labeling

1. Identify the major components of a food label.
2. Identify and classify functions of chemicals, additives, and ingredients which are found on food labels.
3. Explain the functions of specific elements of a food label.
4. Identify and explain the responsibility of food processors and the role that food labels have in the production of a food product.
5. Read a label and compare nutrition information of various food ingredients.

Activity 1: Labeling the Ultimate Pizza

1. Identify the important parts of a label and explain the reason for food labeling.

Activity 2: What's in a Label?

1. Describe the various functions of additives in our food products.

Lesson 2: Food Economics

1. Indicate the size and scope of the food industry in the U.S.
2. Explain how the Consumer Price Index (CPI) is calculated.
3. Explain how money is spent within the food industry.
4. Explain the food industry system, farm to retail.

Activity 1: Comparison Shopping

1. Compare the prices between fast foods and foods prepared at home.

Activity 2: Consumer Price Index

1. Determine price changes in the market and identify and explain factors which influenced these changes.

Unit 2: Careers in Food Science

Lesson 1: Careers in Food Science

1. Identify various food science careers and their educational requirements.
2. Discuss the different food science occupations involved in the production of a food product.
3. Identify post secondary institutions that have a food science program.
4. Identify local food science/processing companies.

Activity 1: IFT Video "In Good Taste"

1. Become aware of career opportunities in the food science industry.

Activity 2: Sensory Evaluation

1. Discriminate between processed poultry and meat products using basic sensory evaluation techniques.

Unit 3: Food Processing/Engineering

Lesson 1: Food Processing

1. Identify and explain the food processing procedures used in the U.S. to maintain and preserve foods.
2. Explain the conditions necessary for microbial growth and the role processing plays in retarding this growth.
3. Define the important terms for processing foods.
4. Explain the process for making a cultured dairy product. Explain the difference between "good" and "harmful" bacteria and how these bacteria are controlled in the production of dairy products.

Activity 1: Dairy Products Lab

1. Explain the basic emulsion principles used when butter, cheese, and ice cream are made.

Activity 2: Making Yogurt

1. Explain the difference between "good" and "harmful" bacteria and how these bacteria are controlled in the production of yogurt.

Lesson 2: Heat Processing and Food Irradiation

1. Identify and explain the various types of processes used to preserve and protect foods through the use of thermal procedures.
2. Explain how to safely can foods using heat processing.
3. Explain food irradiation and how it is being used in the food industry and the controversy that surrounds this issue.
4. Explain how food dehydration works.
5. Identify and explain the terminology associated with heat processing.

Activity 1: Food Dehydration

1. Observe the effects of dehydration on food as a method of preservation.

Lesson 3: Frozen Foods

1. Identify and explain terminology relating to freezing of foods.
2. Determine the procedures to use when purchasing and storing foods in the home freezer and the problems (microorganisms which can grow at or near freezing temperature).
3. Identify and explain what happens to food when it is stored in a freezer with improper wrapping.
4. Explain refrigerator load and calculate BTUs needed given the parameters of specific foods.
5. Explain the relationship between temperature and chemical reactions within foods.

Activity 1: Freezing Experiment

1. Examine the effects of packaging a food with a variety of common packaging materials.

Activity 2: Calculation of Refrigeration Load

1. Calculate the amount of BTUs required to cool a food product.

Lesson 4: Packaging

1. Identify and explain the requirements and functions of food containers.
2. Explain the importance packaging has on protecting the quality and safety of foods we consume.
3. Explain the effect packaging materials have on environmental concerns.

4. Explain the value of packaging in the marketing of food products.
5. Design a laminated popcorn package that will improve and explain popping rate.

Activity 1: Effects of Light on Food Flavor

1. Observe and sample the effect light has on the flavor of corn chips stored in different ways for various periods of time.

Activity 2: Popcorn Packaging

1. Investigate the technology behind the POP! in microwave popcorn.

Activity 3: Archeology Food Container Dig

1. Discover the impact food packages have on the environment.

Unit 4: Food Microbiology

Lesson 1: Undesirable Microbial Growth in Foods - Spoilage

1. Explain the concept of available water and its relation to food spoilage/preservation.
2. Describe the morphology and cellular arrangement of microorganisms.
3. Write the chemical equation for the action of catalase.
4. Name three distinguishing characteristics of spoilage bacteria.
5. Define the characteristics of thermophilic, psychrotropic, and mesophilic bacteria.
6. List three basic conditions that promote bacterial growth.

Activity 1: Spoilage

1. Present the various undesirable microorganisms and spoilage patterns in food products with low and high water activity.

Lesson 2: Undesirable Microbial Growth in Foods— Subsurface Mold Growth in Foods

1. Identify the structural parts of common molds.
2. Discuss the difference between aerial and submerged mold growth.
3. Name several methods of food processing used to control mold growth.

Activity 1: Subsurface Mold Growth in Foods

1. Determine the difference between aerial and submerged mold growth and their respective relationship to food safety and spoilage.

Lesson 3: Methods of Preventing Microbial Growth in Foods—Control of Molds in Foods

1. Determine conditions that contribute to mold growth in foods.
2. Identify organic and non-organic preservatives used in the processing/preparation of food.
3. Identify common food preservatives which are best for preventing mold growth in common food products (bread).
4. Differentiate between *Penicillium* or *Aspergillus* mold.

Activity 1: Subsurface Mold Growth in Food—Control of Molds in Breads

1. Differentiate and distinguish the role of molds in spoilage of bread.

Lesson 4: Desirable Microbial Growth in Foods—Experimental Modification of Pickle Fermentation

1. Discuss ways of controlling unwanted microorganisms in food.
2. Discuss salting as a preservative method.
3. Name three pickled vegetable products.
4. Modify factors that impact on pickle fermentation and quality of finished product.

Activity 1: Experimental Modification of Pickle Fermentation

1. Modify one or more factors that would have a major impact on the pickle fermentation, and therefore, on the quality of the finished product.

Lesson 5: Desirable Microbial Growth in Foods—Yeast Fermentation

1. Describe the role of bacteria, mold(s) and yeast(s) in food processing and/or production.
2. Evaluate baked products through selected criteria that reflect variations in ingredients and preparation techniques.
3. Describe the morphology and chemical aspect of the fermentation process.
4. Name five foods which are processed via yeast fermentation.
5. List the three basic conditions which bacteria need to grow.

Activity 1: Yeast Fermentation

1. Observe the function of a yeast and compare the density of fermented dough with control (non-fermented dough).

Activity 2: Variation in Carbon Dioxide (CO₂) Production

1. Observe and compare the development of carbon dioxide from yeast, water and varying amounts of sugar.

Food Safety

Unit 5: Consumer Education

Lesson 1: Quality/Abundance/Choice

1. Identify the types of food eaten in the past.
2. Compare and contrast the eating habits of Americans in the 1990's versus Americans in the Pre World War II era.
3. Estimate the total amount of money spent on food during a typical week.
4. Describe the importance of chemicals and technology to food production.

Activity 1: A One-Week Look at My Food Consumption and Cost

1. Evaluate the type and quantity of food consumed during one week.

Activity 2: A Blast to the Past

1. Become familiar with the ways that Americans eating habits have changed during the 20th century.

Lesson 2: Storage/Transportation/Packaging

1. Explain how people work together to ensure a safe food supply.
2. Describe the proper procedures for food storage and increase the storage time of certain food products.
3. Describe how to safely pack a cooler for a trip or vacation.
4. Explain the importance of proper food packaging.

Activity 1: Potato Chips and Oxidative Rancidity

1. Explain the presence of off-flavors in food products caused by oxidative rancidity
2. Identify practices for controlling oxidative rancidity.
3. Predict deteriorative changes in food products containing high amounts of unsaturated and polyunsaturated fats given certain conditions of processing and storage.

Activity 2: Bacteria Are Found Everywhere

1. Comprehend that microorganisms are found everywhere and can grow under favorable conditions.

Unit 6: Biotechnology

Lesson 1: Biotechnology in Food Safety

1. Define biotechnology and provide examples of where biotechnology is utilized in production of food processing, production and the development of food and fiber.
2. Explain the impact of biotechnology on food safety, human health and wellness.
3. Define three examples of microbial biotechnology related to food safety.
4. Identify the economic and ethical advantages and disadvantages of using biotechnology to produce, process and preserve food products.

Activity 1: A Bioengineered Food Product

1. Explain the use of biotechnology in the efficient and economical production of food products.
2. Process hard curd (the primary step in cheese production) using rennin.

Activity 2: Isolation of DNA From Yeast

1. Simulate the isolation of DNA from an agricultural product.

Unit 7: Risk Assessment

Lesson 1: What is Risk?

1. Explain what risk is and compare it to known events.
2. Identify and explain the real risks associated with life experiences.
3. Explain the risks associated with potential carcinogenic hazards.
4. Explain risk and benefits of using pesticides to produce foods.

Activity 1: Risk/Benefit

1. Identify risks/threats to our food supply and to describe possible causes and remedies to those threats/risks.

Activity 2: Personal Control of Risk

1. Explain how we can control actions which may lead to a premature cause of death.

Lesson 2: Food Safety Decisions

1. Identify and explain the differences between the public's ranking of food safety concerns and the FDA's ranking of food safety concerns.
2. Explain how pesticides can be effectively reduced in the diet.
3. Evaluate, analyze, and compare messages which are sent to the consumer concerning food safety issues.
4. Identify what signals to be aware of in food safety messages which might be "loaded."
5. Determine the amount of iron supplement which is added to the diet, as well as the input this product can have on human health safety.
6. Explain the "zero risk" concept, identify and evaluate the threats to our food supply, causes for these threats and possible remedies.

Activity 1: Understanding the Media—Food Safety Decisions

1. Develop analytical skills needed to evaluate the messages consumers receive about food safety issues in the media.

Activity 2: Nitrates in Meat—Food Safety Decisions

1. Observe the differences between fresh red meat with and without sodium nitrate added, and observe the changes after both samples are heated.

Unit 8: Toxicology

Lesson 1: Toxicology

1. Explain the level of chemical residues found on foods.
2. Explain the legal use and restrictions of pesticides on food crops.
3. Explain how plants and animals are used to evaluate the amount of chemical residues present in foods.
4. Explain how animals are used to test for carcinogenic substances.

Activity 1: Testing Pesticide Residue

1. Examine the effects of a residual chemical on the water flea, *Daphnia magna*.

Activity 2: Pesticide Residue Testing Using Black-Eyed Peas

1. Perform a simulated test for the presence of pesticide residues.

Lesson 2: Natural Toxins

1. Identify common substances which are toxic to humans.
2. Define toxicity and explain the role moderation has in our lives.
3. Identify common food allergies that are hazardous to certain individuals.
4. Explain conditions under which natural toxins can cause negative consequences.
5. Experiment with natural toxins to develop a pesticide.

Activity 1: Naturally Occurring Toxin Poster

1. Develop a poster that students can share with others to inform them of the potential problems associated with naturally occurring toxins.

Activity 2: Natural Toxicants—Testing for Toxicants

1. Determine the level of natural food toxicant solanine which is lethal to the water flea, *Daphnia magna*.

Unit 9: Regulations that Protect Our Food Supply

Lesson 1: Regulations that Protect Our Food Supply

1. Identify the agencies that determine food safety regulations.
2. Identify regulations that food processing companies follow to produce a safe food product.
3. Describe the process of inspecting a food facility for safe sanitation practices.
4. Collect and analyze data on a food facility's sanitation process and compare with that of peers and ideal standard.

Activity 1: Food Products—Who Regulates Them?

1. Become familiar with the regulatory process of food products.

Activity 2: Inspecting A Food Warehouse Facility - The Checks For Success

1. Become familiar with the inspection procedures of a food warehouse facility.

Unit 10: Production's Effect on Food Safety

Lesson 1: Organic Farming

1. Identify what constitutes an organic food and how they are regulated.
2. Differentiate the cost of organic and conventionally grown foods.
3. Determine if organic foods are more nutritious than conventional counterparts.
4. Determine whether organic foods are safer than foods grown with the help of agrichemicals.

Activity 1: Becoming Familiar With the Agrichemical Industry

1. Comprehend how modern food production relies on agrichemicals to provide safe and healthy foods with a major concern toward the environment, humans and animals.

Activity 2: Comparing the Growth of Organically-Grown to Conventionally-Grown Plants

1. Identify whether livestock wastes can be used as an alternative fertilizer resource, producing the same growth and development characteristics as compared to plants that have been treated with an inorganic or commercial fertilizer.

Lesson 2: Processing and Field Packaging

1. Understand that proper food processing improves food quality.
2. Realize that nutrient retention is enhanced through food processing.
3. Learn the importance and methods of food processing.
4. Determine how fruits and vegetables are packaged and stored.
5. Develop an understanding of how potatoes are harvested and stored.

Activity 1: Preserving Foods

1. Describe how molds can be controlled through the use of organic acid which act as preservatives.

Activity 2: Effects of Various Cooling Methods on Fruit and Vegetable Tissue Quality

1. Determine the effect of various cooling methods on fruit and vegetable tissue quality as determined by their appearance and weight loss.

Unit 11: Safe Handling of Food

Lesson 1: Safe Handling Beyond the Retail and Wholesale Shelf

1. Identify food handling conditions that are potential antecedents to a food borne illness(es).
2. List five food handling practices that will reduce the incidence or potential of food borne illness(es).
3. Conduct bacteriological examination of food equipment and eating utensils.
4. Conduct chemical analysis of milk samples stored/handled several different ways.
5. Identify five food purchasing safety practices.
6. Identify five food storage safety practices.

Activity 1: Bacteriological Examination of Food Equipment and Eating Utensils

1. Emphasize the importance of clean equipment and sanitary practices in food preparation and processing.

Activity 2: Bacteria in Milk—A Chemical Analysis

1. Emphasize the importance of sanitary and safe handling practices in milk handling and processing.

Unit 12: Nutrition

Lesson 1: Consumer Education

1. Identify and list the information provided by a label on a retail food product.
2. Evaluate the influence of the media in communicating nutritional facts and myths.
3. Identify the scientific basis for refuting the claims of food companies in promoting specific foods or additives to foods to improve one's health.
4. Collect and analyze the nutritional components of daily dietary intake and compare with that of peers and ideal standard.

Activity 1: Reading Labels on Products Containing Sugar

1. Become familiar with labeling on processed foods.

Activity 2: Designing a Package for a Food Product

1. Identify and list the information necessary on a retail food label.

Unit 13: Basic Components of Food

Lesson 1: Basic Components of Food

1. Identify food components and describe their nutritional contribution to diet.
2. Quantify the amount of water and fat in various food products.
3. Describe the nutritional value of selected food products.
4. Describe how food scientists have altered food's basic components to develop innovative products in meeting consumer demands.

Activity 1: Identifying Basic Components of Food

1. Determine the presence of complex carbohydrates, simple carbohydrates, protein, fat, minerals, and vitamin C in common foods.

Activity 2: Effects of Changing to a Low Fat Milk

1. Quantify how many calories and how many grams of fat would be saved by changing to lower fat milk.

Unit 14: Effects of Food on Health

Lesson 1: Effects of Food on Health

1. Describe the effects of current diet in relation to daily activities.
2. Describe the effects of diets on long term health.
3. Describe the cause and effect relationship between food intake and wellness.
4. Explain the specific effects of nutritional deficiencies in human diets.

Activity 1: Nutritious Oatmeal Cookies

1. Prepare oatmeal cookies with varying levels of soy flour in order to produce a cookie that is more nutritious than the traditional recipe, but still tastes good.

Activity 2: Dining at McDonald's

1. Evaluate the nutritional impact of eating at McDonald's for a full day.

Lesson 2: Enhancing the Nutritional Value of Our Foods

1. Identify examples of what the food industry has done to enhance the nutritional value of our diets.

2. Describe the scientific methods used by the food industry to enhance the nutritional value of processed foods.
3. Describe the sequence of events that occur during the development of a low fat food product.

Activity 1: Preparing Low Fat Mayonnaise Products

1. Prepare mayonnaise with little or no cholesterol, that has as good an appearance, taste, and texture as regular mayonnaise.

Activity 2: Binding Water in Meat Products

1. Prepare ground beef with varying levels of salt and rice in order to produce a product that is more nutritious than traditional lean/fat mixtures, but still tastes good.